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## CHEMICAL CRYSTALLOGRAPHY.

*Chemische Krystallographie.* By P. Groth. Erster Teil. Pp. viii+626. (Leipzig: W. Engelmann, 1906.) Price 20 marks.

THE appearance of the first volume of this monumental work by Prof. P. von Groth marks an epoch in the history of crystallography. Ever since it was known that the famous editor of the *Zeitschrift für Krystallographie* had such a work in progress, expectancy has been of the keenest in the mineralogical and crystallographical world. That the book would be worthy of the man was felt to be assured, and the event has fully justified such confidence. It is to be published in four volumes, and if the other three are equal to the first now before us, the whole will form a compendium of crystallographic knowledge which for completeness, detail, and accuracy will stand unique. The work will include practically the whole of our crystallographic knowledge concerning every crystallised substance yet described.

There can be no doubt that Prof. von Groth is particularly marked out by circumstances for the compilation of such a *magnum opus*. For not only has he edited the *Zeitschrift für Krystallographie* since its inception by him thirty years ago, but he has exhibited from time to time, especially by the rapid succession of new editions of his standard text-book, "Physikalische Krystallographie," and his smaller but not less interesting "Einleitung in der chemische Krystallographie," a remarkable gift of assimilating, weighing, collating, and presenting in readable and indeed highly interesting form the chief advances in crystallography as they occur. His most careful personal editorship of every paper of importance which is published in the *Zeitschrift* has rendered him familiar with these advances in all their details. Moreover, his reputation as a teacher has made his laboratory at Munich the resort of as earnest and enthusiastic a class of students as is to be found anywhere. Hence this book will be received by all those interested in crystallography with a quite unusually warm welcome, deeply tinged with reverence, partly on account of the excellence of the material which the book itself contains, but in even greater measure because of the respect with which every word uttered by the great master and universally acknowledged *doyen* of his subject is received.

In Britain the book will meet with an exceptionally cordial reception from the small band of our native crystallographers, who have ever been treated by Prof. von Groth with particular kindness, and have received from him the strongest encouragement, and never more so than at times when it has unfortunately been only too evident that the study of crystals was not appreciated in this country. The writer of this review can never forget the more than kind encouragement extended to him by Prof. von Groth during the earlier stages of the organised series of researches which the writer inaugurated in the year 1891 on the alkali sulphates and selenates and their double

salts, and which had for their first object the introduction of greater accuracy into crystallographic methods. Prof. von Groth has frequently expressed the wish that the country of Miller, the father of modern crystallography, should take a much greater part in the advance of crystallography than she was doing some fifteen years ago. Now, however, at last the small band of British workers, partly from the stimulating influence of such encouragement, has been able to make some impression, and not only mineralogists, who have alone in the past appreciated crystallography at its true value, but chemists, to whom its intrinsic value is immeasurable, as well as metallurgists and physicists, are awakening to the fact that the study of crystals is the study of solid matter in its highest, most perfectly organised form, and that it is likely to lead to the most important fundamental truths. Already the researches just alluded to have afforded a final and irrefragable proof of the accuracy of Haüy's original conception that to every definite chemical substance there appertains a distinct and characteristic crystalline form, and have reconciled this with Mitscherlich's discoveries in isomorphism by revealing an exquisitely beautiful relationship, connecting very small angular differences which are found to occur between the crystals of the various members of isomorphous series with the atomic weight of the interchangeable elements composing them. This generalisation not only defines the real meaning, extent, and scope of Mitscherlich's law, but also proves that the supposed exceptions are not such, and, therefore, the absolute truth of the rule that difference of chemical composition does in all cases involve difference of crystalline form.

That the subject to the advance of which Prof. von Groth has devoted himself is indeed of the intrinsic importance which the writer has recently claimed for it, in a couple of articles in the engineering supplement of the *Times*, is strikingly demonstrated by the fact that the very groundwork of chemistry, the law of valency, has been shown in a remarkable paper by Prof. Pope and Mr. Barlow, read recently to a crowded audience at the Chemical Society, to be clearly connected with, if not dependent upon, the internal structure of crystals. This most interesting theory carries the conception of "topic axes," which express the relative structural dimensions of the crystals of isomorphous series, and which were introduced simultaneously by Dr. (now Prof.) Muthmann, one of Prof. von Groth's pupils and assistants, and the writer in the year 1894, a step further so as to include no longer merely the members of isomorphous series, but also substances of the most diverse characters; and whatever may be the fate of this theory, it can no longer be doubted that crystallography must play a much more important rôle among the subjects of science in the future than it has played in the past.

The present juncture, therefore, is a most opportune one for the appearance of Prof. von Groth's great book. It will be invaluable to all crystallographical investigators, and particularly so as an excellent bibliography of all the important investigations up to date

is included, concerning every substance discussed. This first volume deals with the solid elements, with the inorganic compounds of a non-saline character, such as oxides, sulphides, and phosphides, and with the halogen salts, cyanides and salts of the recently discovered nitrogen acids. The second volume is to deal with the inorganic oxy- and sulpho-salts and the remaining inorganic crystalline compounds, while the third and fourth volumes are to treat of the organic compounds. The arrangement of the text is that each group is described, as regards its general characteristics, in an introductory statement in large type, and this is then followed by the detailed description of each member of the group in smaller type.

An excellent *résumé* of the crystallography of the naturally occurring minerals is given, but it is the detailed crystallography of the substances requiring to be prepared chemically, and the descriptions of which cannot be found elsewhere except by reference to the widely scattered original memoirs, that renders the book so priceless, for it presents the essential results of all chemico-crystallographical investigations right up to date. The illustrative figures of crystals are neat and clear, and the text easy, the large type even luxurious, to read.

One important feature has been left to the last to refer to, namely, that the symmetry of the crystals of each substance dealt with is given in accordance with the much more scientific method of classification recently adopted as the outcome of the completion by Schönflies, Fedorow, and Barlow of the geometrical theory of homogeneous structures, which enables the particular individual class represented in the substance under discussion to be at once identified from among the thirty-two possible classes of crystal symmetry.

In conclusion, with regard to the contents of this book, the best of all possible praise can conscientiously be bestowed in saying that it is worthy of the mastermind that conceived it.

A. E. H. TUTTON.

#### A NEW WORK ON ORGANIC EVOLUTION.

*The Analysis of Racial Descent in Animals.* By T. H. Montgomery, jun. Pp. xi+311. (New York: Henry Holt and Company; London: George Bell and Sons, 1906.) Price 10s. 6d. net.

IT would be a most fascinating task to trace the evolution of modern methods of dealing with the problems of life. Differentiation has taken place so extraordinarily quickly. The time is long past when one man can attempt to grapple with the whole problem. Not only so, but the time seems to be past when one man can even be interested in the whole problem. Evolutionists may be broadly classified into those to whom the problem of evolution is the problem of the origin of species and those to whom it is the problem of adaptation. The key-note of de Vries's "Mutationstheorie" is the solution of the problem of species; we even go so far as to say that this is the achievement of de Vries's work. The logical conclusion, the complete working out of the theory of

natural selection, is reached in Dr. Archdall Reid's "Principles of Heredity." The interest of the two authors is entirely different. De Vries's interest is in the origin of species, Dr. Reid's in natural selection. Darwin's interest was in both; if we look no further than the title of his chief work we can see this—"On the Origin of Species by Means of Natural Selection."

The fact that these two interests have segregated, and the way in which they have segregated, are both very suggestive, and the direction in which they point is the same. The fact of segregation suggests that the association of the two ideas was unnatural, and that they were not capable of union. The way in which they have segregated confirms this suspicion. For those who devote their attention to the question of species reject natural selection, while those who elaborate the theory of natural selection find no support in the phenomenon of specific difference. All possibility of a reconciliation between the divorced ideas is put an end to by Meyrick, who probably knows more about specific difference than anyone else. In his handbook of British Lepidoptera he says that, in seeking for the most suitable characters by which species may be distinguished, those which can in any way be regarded as useful to the species must be discarded without more ado.

It is not surprising that Darwin's work should have borne fruit which segregated in this way. The case is thoroughly Mendelian. Darwin's work was a cross between a biological theory of evolution and a social and industrial theory of competition. The hybrid, more vigorous than either parent, took the world by storm. We are now witnessing its posterity separating out more or less simply into the two forms which were united in the beginning. Just as every plant in the  $F_1$  generation contains yellow and green peas, and just as it is not until the next that there can be found plants bearing only yellows or only greens, so Darwin's interest was in the "Origin of Species by Natural Selection," while now we find de Vries, who is absorbed entirely with the former, and Reid entirely with the latter.

The immediate result of Darwin's work was the flood of energy which spent itself in tracing out the genealogical histories of organisms. To such lengths did the students of phylogeny go, so remote from reality did their speculations become, that the study of phylogeny has fallen into discredit in the eyes of a great many of those who are looked up to as biological thinkers to-day.

Prof. Montgomery's interest is centred neither in species nor in selection, but in phylogeny. He admits that phylogeny has been discredited by the indiscretion and shallowness of a number of its exponents, but he contends that if we limit ourselves to the strictly experimental method we are neglecting an enormous range of phenomena.

"For living organisms are in number and variety hardly commensurate with the vast assemblage of their ancestors. Are we then to leave out of consideration all this once existing life, simply because